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Notes on the Siluro-Devonian *Ischadites stellatus* (Fagerstrom 1961), a Dasycladaceous Alga

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ABSTRACT

The Devonian *Ehlersospongia stellata* Fagerstrom, 1961 is redescribed as *Ischadites stellatus* and placed among dasycladaceous algae. The stratigraphic range of *I. stellatus* is extended to Silurian (Niagaran). The ecology of Silurian receptaculitids is discussed and the position of gametangia of *I. stellatus* is considered.

INTRODUCTION

This paper is a part of a larger study of North American receptaculitids as algae and consists of the redescription of *Ischadites stellatus.*

Fagerstrom (1961) described and illustrated *Ehlersospongia stellata* (fig. 1) as a new Middle Devonian fossil, and illustrated a fragmentary impression of the same species under the name *Receptaculites* sp. Fagerstrom assigned receptaculitids to a family Receptaculitidae of uncertain phylum, class, and order. Byrnes (1968) considered *Ehlersospongia* Fagerstrom, 1961 a synonym of *Ischadites* Murchison, 1839 which he placed in the family Receptaculitaceae Eichwald, 1860 of the plant order Dasycladales. Rietschel (1969) listed *Ehlersospongia* as one of five genera in the Receptaculitaceae without any comments, and without any discussion of the Fagerstrom (1961) paper. He considered receptaculitids as a separate order of algae.

Byrnes' (1968) assignment is here supported, and *I. stellatus* is redescribed as a dasycladaceous alga. The ecological interpretation

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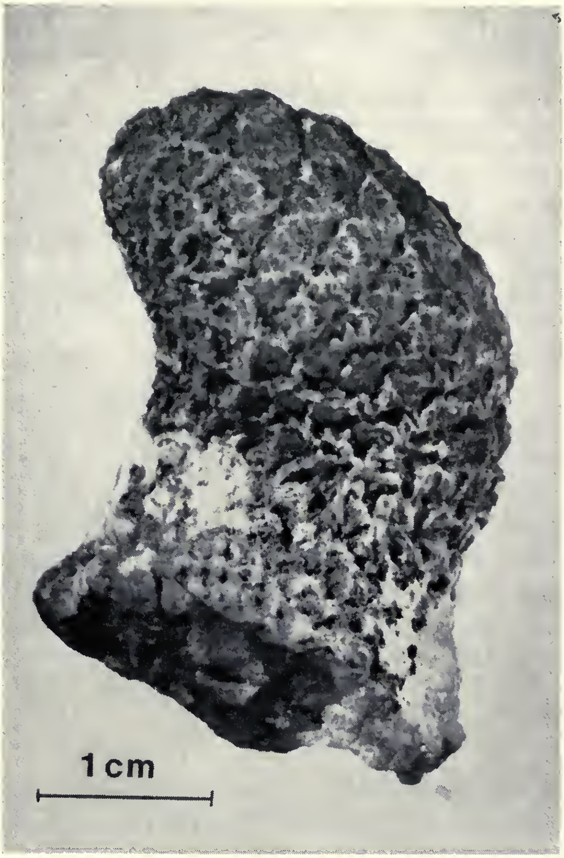

FIG. 1. *Ischadites stellatus* (Fagerstrom, 1961). Holotype, U. Mich. Mus. Paleontol. 36111. Middle Devonian (Formosa Reef). Greenock Creek, Brant Twp., Bruce County, Ontario.

of the habitat of *I. stellatus* is considered and its stratigraphic range is extended to Niagaran (Silurian).

ECOLOGY

This species is known only from Silurian and Devonian reefs or bioherms. The Silurian fossil from the Chicago area (fig. 2) came from the top of the reef. The exact positions within the reef of the Devonian specimens (fig. 1) from Canada are unknown. It is of interest that other Niagaran and Devonian receptaculitids are also reef inhabitants. Cyclocrinitids have been reported from the top of the

Racine reef in the Chicago region (Lowenstam, 1957; Nitecki, 1970) and the calathiids from the inter-reef regimen (Fisher, 1925; Bretz, 1939). In the Chicago Silurian the genus *Ischadites* is represented by *I. stellatus* as well as *I. koenigii, I. hemisphericus*, and *I. abbottae.* All four species are found on top of Niagaran reefs. Rietschel (1969) reports that European Silurian receptaculitids are often associated with reef structures, and that Devonian representatives are almost exclusively found on reefs. He also observes that receptaculitids are located within the central area of reefs. This is comparable to the distribution of American Niagaran ischaditids. Rietschel's interpretation of the nature of the environment at the top of the reef as that of a quiet water is, however, not applicable to North American reefs, the top of which undoubtedly represented rough water environments. In his study of Silurian reefs Lowenstam (1957) considers *Ischadites* an "aberrant" sponge and finds it abundant among the biota of the rough-water portion of the reef. He correctly considers *Cerionites* [=*Cyclocrinites*] a related, allied or even congeneric form. Lowen-

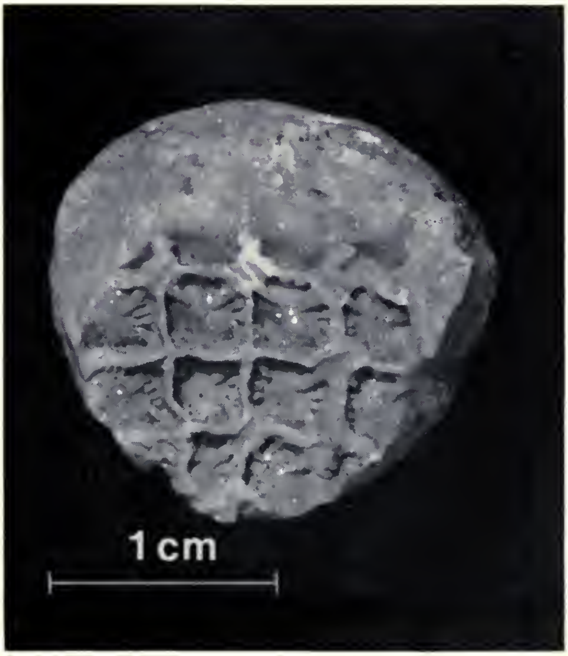

FIG. 2. Head and stellate structures of *Ischadites stellatus* (Fagerstrom, 1961). Field Mus. Nat. Hist. PP 17343. Silurian (Racine Dolomite). Bridgeport Quarry, Chicago, Illinois.

stam apparently examined a considerable amount of Niagaran receptaculitid material both in the field and in various museums. He follows Dacqué's (1921) argument that the receptaculitid skeleton was so constructed as to form "a mechanism of loosely overlapping components so arranged as to translate vertical pressure through lateral movements in the manner of the leaves of a spring" (Lowenstam, 1957, p. 245). He further argues that such adaptation was of value in the wave-swept reef surfaces, but was of questionable worth in quiet water habitats. This is an attractive argument that could possibly be applied to certain receptaculitids, but it cannot serve as a generalization to all known forms. The stellate structures of most cyclocrinitids are not in overlapping contact with each other and are below the distinctly globose lateral heads that are in contact with each other. The stellate structures of Amphispongieae are extremely thin and fragile organs, unable to withstand any pressure. In certain representatives of the genera *Ischadites* and *Receptaculites* the stellate structures consist often of more than four ribs and sometimes of fewer. In *Ischadites abbottae,* the elements of stellate structures in older parts of the thallus are well fused and are hence unmovable. Further, according to Dacqué (1921) the plates forming the external skeleton have no significance so far as the movable skeleton is concerned. However, the receptaculitid skeleton is seldom flattened out, the "outer plates" form a firm part of the skeleton and together with stellate structures and inflated lateral ends form rigid lateral heads. Dacqué's (1921) figure 281, supposedly illustrating his argument, is composite and consists of three illustrations. His figure 281A is a copy of the upper figure on Phillips' (1841) plate 59 of *Sphaeronites tessellatus.* His figure 281B is a copy of a fragment of Rauff's (1892) plate 2, figure 4 of *Receptaculites neptuni.* Dacqué's figure 281C appears as a modification of Rauff's plate 7, figure 12 of *Polygonosphaerites tessellatus.* I am not able to comment on the validity of the taxonomic assignment of these various fossils, but Dacqué's figure 281 certainly does not represent one organism, and only his figure 281B illustrates a member of the genus *Receptaculites.*

Finally, Lowenstam (1957) states that "among [Niagaran] reef dwellers, we miss altogether such elements as the calcareous algae. . . . The niche of *Halimeda* of today was, in Niagaran times, occupied by the similarly jointed crinoids." Since cyclocrinitids have been recognized as dasycladaceous algae for the last 70 years (Stolley, 1896), and since receptaculitids are now believed to belong among the green algae (Kesling and Graham, 1962; Nitecki, 1967 and subsequent; Awramik and Cameron, 1968; Byrnes, 1968; Rietschel, 1969) the Niagaran reef community did, indeed, include calcareous algae.

Thus, although receptaculitids are associated with reefs, it is not certain that they were actually reef builders. Comparison with recent calcareous algae in general and with Dasycladales in particular is beset with difficulties. The adaptations of some groups of recent Dasycladales to various environments is of an ecological interest. Unfortunately, little physiological or ecological data are available upon the distribution of these forms. For example, a beautiful and delicate member of the family, *Batophora oerstedii* J. G. Agardh, has a wide geographic distribution. It is found in warm, quiet, marine waters of lagooons, growing below but close to the low-tide level in the Gulf of Mexico and in the Caribbean. Taylor (1960) points out that it can prosper in brackish and even under seemingly fresh-water conditions. Breder (1934) notices an abundant occurrence of *Batophora* in a fresh-water lake on Andros Island, Bahamas. Proctor (1961) reports *Batophora oerstedii* from the series of brackish ponds and lakes in and around Bottomless Lakes State Park, Chaves County, New Mexico, some 500 miles from the nearest Gulf Coast locality! During the warmer months, fertile specimens with numerous gametangia are very abundant and form thick growths. Proctor also reports *B. oerstedii* from the mangrove thickets in Yucatan. He considers that possibly the birds acted as the dispersal agent over the large distances. Thus, although recent Dasycladales predominate in the tropic shallow marine environment, the example of *B. oerstedii* cautions comparisons of recent forms with the Paleozoic fossils as indicators of environmental conditions.

SYSTEMATIC DESCRIPTION

Dasycladales Pascher, 1931

Receptaculitaceae Eichwald, 1860

Receptaculiteae Nitecki, 1969

Ischadites Murchison, 1839

Discussion.—Nitecki (1969) redefined the genus as possessing stellate structures consisting of four ribs. This concept of the genus is now modified and *Ischadites* is considered to include forms with varying numbers of ribs in stellate structures.

Ischadites stellatus (Fagerstrom, 1961). Figures 1–3.

? *Receptaculites neptuni*, Stauffer, 1915, p. 229.
Ehlersospongia stellata, Fagerstrom, 1961, p. 5, pl. 3, figs. 21–23.
Receptaculites sp., Fagerstrom, 1961, p. 5, pl. 3, fig. 24.

Definition.—Small globose ischaditid with stellate structures consisting of four major and eight alternating smaller ribs; Silurian (Racine) to Devonian (Formosa Limestone); Illinois and Ontario; reefs only.

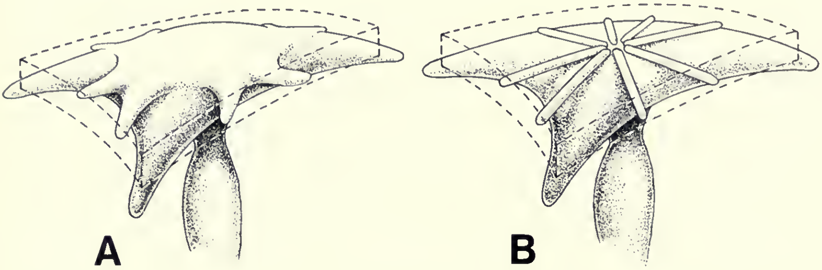

FIG. 3. Diagrammatic interpretation of the head of *Ischadites stellatus* (Fagerstrom, 1961). A, All eight ribs of the stellate structure form one unit. B, The upper ribs are calcareous sheets of gametangia.

Description.—The thallus is subpyriform to globose with rounded apex. The attachment at the lower end is not preserved. Main axis is unknown. Laterals appear to be arranged in a spiral as in other members of the genus; however, due to the obliteration of parts of the surface the spiral cannot be traced. The spiral is packed so closely that laterals appear to form whorls, and there appear to be about 18 laterals in the "whorl."

The terminus of the lateral branch is more complex than in any other ischaditid. It consists of the characteristic two pairs of major ribs of stellate structures, one arranged somewhat above the other, and a distally placed smaller pair found between the major ribs (fig. 3A). The head of the lateral is thus in effect formed by the eight shorter stellate ribs.

All specimens are now preserved as casts, and the holotype is preserved in its growth position with the apex somewhat to the side. The thallus appears bent in the manner of many ischaditid specimens.

Discussion.—This species differs from all other ischaditids in possessing more than four ribs in its stellate structures. In its external anatomy it is closely related to *I. koenigii* from the Silurian of the

Mississippi Valley. It differs from *koenigii* in the morphology of the stellate structure, and it is similar in this respect to the Ordovician *Receptaculites oweni* in which the stellate structures are also many-ribbed. In *R. oweni,* however, the many ribs of the stellate structure are less regularly defined. It seems that both *R. oweni* and *I. stellatus* have converged to this condition, but, of course, it also is possible that the many-ribbed stellate structure is a primitive character retained in these two taxa.

Whether *Receptaculites neptuni* from Stauffer's (1915) check list of Devonian fossils is the same species cannot be determined.

Gametangia.—The lateral heads are relatively large and could possibly have housed gametangia. If this was, indeed, the case, gametangia could have been dispersed among the secondary ribs of the stellate structures, or the secondary ribs could have been the calcareous sheaths of gametangia (fig. 3B). Among recent Dasycladales the gametangia are sometimes cemented together in rows (*Neomeris annulata* and *N. cokeri*) or even arranged in gametangial rays (various species of the *Acetabularia* complex).

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